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	DB=USPT; PLUR=YES; OP=OR		
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L12: Entry 20 of 22 File: USPT Apr 16, 2002

DOCUMENT-IDENTIFIER: US 6373377 B1
TITLE: Power supply with digital data coupling for power-line networking

Brief Summary Text (5):
There has recently been a growing interest in the use of power lines for high-speed data networking. For instance, the HomePlug.TM. Powerline Alliance was formed to enable and promote the rapid availability and adoption of cost effective, interoperable and standards-based power-line home networks and products. To date, power-line networking technology delivering 14 Mbps networking speeds over residential (home) power lines has been demonstrated. With a high-speed power-line network, it is expected that virtually any electronic device found in the home may be networked through the power line.

Brief Summary Text (6):
For a power-line home network, direct current (DC) power in a computer system has been generated on an isolated or computer system side of a power supply, typically a switching power supply. Power-line network access circuitry such as a power-line analog front end (AFE), a digital-to-analog converter (DAC) and an analog-to-digital converter (ADC) has been driven by DC voltage from the system power. In order to drive a power line, a transformer has been necessary in the AFE for isolating the computer system side (isolated side) from the power line side (non-isolated side). Given the relatively low DC voltages typically used by integrated circuitry in the AFE on the isolated side, a transformer has also been necessary to achieve an adequate signal voltage level needed to drive a data carrier on a power line or power-line networking. However, the use of a transformer to amplify the power line data carrier increases the output impedance of the transmitter driver and introduces undesirable attenuation in the receive path. The isolated side typically provides DC voltages of +3.3 volts, +5 volts and +/-12 volts. With 3.3 volts, which is typical of most cost-effective AFE integrated circuitry, it would be very costly and difficult, if at all possible, to directly drive a data carrier into the power line with an adequate signal amplitude. As a result, an extra chip is required as a large signal amplifier driver having a larger power supply voltage of +/-12 volts to obtain adequate voltage swing to drive a data carrier onto the power line.

Detailed Description Text (9):
With the digital coupler 136, data signals are transmitted or received between the power-line network access circuitry side and the power supply side in digital form. The digital coupler 136 may be implemented as a direct parallel connection, serial connection or a combination thereof. For example, data can be sent with a parallel interface while control signals are coupled with a serial interface, depending on the speed of the digital interface and the required control data rate. The digital coupler 136 may be direct, capacitive, resistive, inductive, optical or a combination thereof. The digital data provided through the digital coupler 136 may be modulated over a high-frequency digital data carrier for transmission through the digital coupler 136.

Other Reference Publication (10):
Patrick Spreng, Standards Watch: HomePlug Selects Intellon's PowerPacket For Powerline Home Networking Specification, Decision by Industry Technical Experts

Sanctions PowerPacket As Premier Powerline Technology for Connecting the Digital Home, Jun. 14, 2000, Data.com. pp. 1-2.

Other Reference Publication (11):
HomePlug.TM., The HomePlug Powerline Alliance, Background Paper, Apr. 2000, .COPYRGT. 2000 HomePlug, pp. 1-2.

Other Reference Publication (12):
HomePlug.TM., Powerline Alliance, Overview, .COPYRGT. HomePlug, 1 page.

Other Reference Publication (13):
HomePlug.TM., HomePlug Powerline Alliance Selects Baseline Technology, Jun. 5, 2000, .COPYRGT.2000 HomePlug, pp. 1-2.

Other Reference Publication (14):
HomePlug.TM., Leading Technology Companies Form Alliance to Establish Specification for High Speed Powerline Home Networking, Apr. 10, 2000, .COPYRGT. 2000 HomePlug, pp. 1-2.

Other Reference Publication (27):
Cahners EDN Access, Hands-on project: Home-network contenders steer a collision course, http://www.ednmag.com/ednmag/reg/1999/112499/24df1.htm, .COPYRGT. 2000 Cahners Business Information, Nov. 24, 1999, pp. 1-6.

Other Reference Publication (28):
Intellon, No New Wires.TM., Press: 2000 Press Releases, HomePlug Powerline Alliance Selects Intellon's PowerPacket.TM. Technology for the New Powerline Home Networking Specification, .COPYRGT. 2000 Intellon, Inc., Jun. 5, 2000, pp. 1-2.

Other Reference Publication (31):
Intellon, No New Wires.TM., High Speed Powerline Network Technology, HomePlug Powerline Alliance selects Intellon's PowerPacket.TM. Technology for the new Powerline Home Networking Specification, .COPYRGT. Intellon, Inc., 1 page.

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L12: Entry 16 of 22 File: USPT Jun 3, 2003

DOCUMENT-IDENTIFIER: US 6574237 B1
TITLE: Inoperable network device

Brief Summary Text (2):
This invention is directed to the field of networking devices, such as networking appliances coupled to a home network.

Brief Summary Text (7):
The conventional view is that when there is a mixed version HPNA system (i.e., at least one V1.x device and at least one V2.x device), when node detection occurs and a V2.x device detects the presence of a V1.x device, the entire link will drop back to the V1.x rate. This drop back procedure is inefficient since it will cause communication between two V2.x devices to occur at the V1.x rate. However, the conventional view is that the drop back procedure is necessary so that V1.x devices can sense the communication between the two V2.x devices, and not erroneously disrupt the communication by attempting to transmit. This approach is inadequate because it does not take advantage of the V2.x capabilities, and instead acts as if the entire network is made of V1.x nodes.

Detailed Description Text (2):
It is valuable to be able to distinguish the advanced capabilities of attached stations in order that the home network can operate in the most efficient, highest performance mode. According to the invention, upon detection of the presence of a V1.x or legacy device, an advanced terminal (e.g. a V2.x device) tags the system as a mixed mode topology, and modifies the preamble of the native mode frame (e.g. a V2.x frame) by prepending a valid V1.x Access ID (AID) to the native mode frame. During the payload portion, if communicating with a V2.x device, the V2.x transmitting device continues to send packets out in its native format and frame structure. In this mixed mode topology, the advanced terminal data throughput is greater than a complete fallback to V1.x legacy rates.

Detailed Description Text (3):
Assuming that multiple generations of CSMA/CD LAN protocols concurrently operate on the wire, share the same spectrum, and differ in modulation types and frame formats, there are two goals of backwards compatibility. A first is to ensure that different generations of HomePNA products can interleave frames on the wire without interfering with each other (compatibility) and a second is that later generation products can communicate with earlier generations (interoperability). It is highly desirable to ensure that later generations of terminals based on the HomePNA specifications are able to communicate at native rates using native modulation schemes even in the presence of mixed mode topology. For example, the V1.x specification (assuming that V1.x devices incorporate the Link Integrity scheme contained in version 1.1 of the HPNA Technical Committee specification) operates at approximately 1 Mbps on the wire. The specifications for the V2.x technology, on the other hand, achieve data rates in the 10 Mbps range.

Detailed Description Text (4):
In one embodiment, the invention takes advantage of an aspect of the V1.x HomePNA specification, which lacks a definition of system behavior when presented with signals of a format different from V1.x signals, such as those used by a future

specification. In particular, the V1.x specification allows implementations that are very prone to detecting foreign transmissions as noise events, resulting in noise threshold adjustments that could render a V1.x terminal incapable of reception. Due to the bursty nature of the data present in home networks, however, legacy nodes will be able to gain entrance into the conversation. This will permit node detection by enhanced generation HomePNA terminals, according to the invention.

Detailed Description Text (7):
Therefore, in an alternative embodiment according to the invention, a default state of the driver assumes that legacy devices are indeed present in the system. The driver periodically "chirps" or queries the line utilizing the modulation type, frame format, and link integrity format of the HPNA V1.x specifications in an attempt to isolate any legacy devices. This chirp does not need to be specifically for discovery. Most systems will attempt to ascertain their network address and will transmit a network address query. The mixed mode endpoint decodes the legacy packet and then sets the corresponding controls for multimode operation.

Detailed Description Text (8):
It is valuable to be able to distinguish the advanced capabilities of attached stations in order that the home network can operate in the most efficient, highest performance mode. Upon detection of the presence of a V1.x node, an advanced terminal tags the system as a mixed mode topology and modifies the preamble of the native mode frame by prepending a valid V1.x Access ID (AID) to the native mode frame. During the payload portion, the V2.x terminal continues to send packets out in its native format and frame structure if the destination of the current packet is to another V2.x station.

Detailed Description Text (10):
FIGS. 1 and 2 show an exemplary multiplexing scheme in which both advanced and legacy node paths are considered. Data path multiplexer 100 is either in a first position (FIG. 1) or a second position (FIG. 2). In systems in which only advanced terminals exist (FIG. 1), the data path multiplexer 100 is set in the first position. In topologies where an advanced node is mixed with all legacy nodes, the data path multiplexer 100 is set in the second position, as shown in FIG. 2. Some consideration at the driver level is given to recognizing when nodes come onto and off of the home network. The ability to configure a system to recognize this is within the capabilities of one of ordinary skill in the art, and is not described here in detail. The resulting data may be used to optimize or establish the settings of data path multiplexer 100.

Detailed Description Text (15):
The invention thus provides a Digital Signal Processing (DSP)-based technique that can be implemented with relative ease and requires no modification to the existing HPNA V1.x silicon-based solutions currently deployed in the marketplace. This advantage is important because, due to the cost effectiveness of the V1.x solution, multiple devices in consumer space will likely become linked to desired high speed home networked devices and computers for the purposes of automation and data sharing.

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L12: Entry 10 of 22 File: USPT Aug 17, 2004

DOCUMENT-IDENTIFIER: US 6778646 B1
TITLE: System and method for coupling multiple home networks

Abstract Text (1):
A system and method for coupling multiple home networks includes a first copper wire network, a second copper wire network, and a high pass coupler disposed between the first and second copper wire networks. The high pass coupler is configured to transfer data signals between the first and second copper wire networks, the data signals having frequencies greater than a maximum plain old telephone service signal frequency. Further, the high pass coupler is configured to prevent cross-talk of plain old telephone service, or voice-band, signals between the first and second copper wire networks. The data signals transferred typically include signals in accordance with the Home Phoneline Networking Alliance standard, and may also include broadband Internet access signals. In one embodiment, the high pass coupler is implemented in a residential gateway device. In another embodiment, the high pass coupler is implemented in a network coupler that couples the copper wire networks while maintaining access points to the first and second copper wire networks.

Brief Summary Text (3):
This invention relates generally to electronic networks, and relates more particularly to a system for coupling multiple home networks.

Brief Summary Text (5):
An electronic device in an electronic network may advantageously communicate with other electronic devices in the network to share data and substantially increase the resources available to individual devices in the network. Electronic networks are often implemented as Local Area Networks (LANs) utilizing dedicated wiring installed for that purpose. The advantages of an electronic network are also desirable in a home-computing environment. A home network allows multiple computers and other electronic devices to share data, Internet access, and peripheral devices such as printers and scanners. A home network may also allow digital voice and video services to be accessed by devices anywhere in the home.

Brief Summary Text (6):
Installing dedicated network wiring, for instance an Ethernet LAN, may not be practical for a home network. One type of home network utilizes the existing copper telephone wiring in the home. Data may be transferred between various electronic devices in the home via the copper wiring without interrupting regular telephone service. Thus, a home network may be established without installing new wires.

Brief Summary Text (7):
Internet service may be provided to a home via a broadband solution such as Digital Subscriber Line (DSL) or cable modem. A home network allows multiple computers to access the Internet using only one DSL line or cable into the home. All of the computers in the network typically must be connected to the same telephone line.

Brief Summary Text (8):
Some homes receive telephone service over more than one telephone line. Often such a home will have one main telephone line and a second line for Internet access, a

dedicated facsimile line, or a family member. This second telephone line may also be utilized to carry data in a second home network. It would be advantageous to allow computers on the second telephone line to exchange data with computers and peripheral devices on the first telephone line. In addition, it would be advantageous to allow computers on the second telephone line to access the Internet using a DSL line or cable; however, installing a second DSL line would not be cost-effective or efficient.

Brief Summary Text (9):
Coupling multiple home networks would maximize the resources available to devices on the network, and would provide broadband Internet access to devices on the network without the cost of additional access lines or cables. Therefore, there is a need for a cost-effective and efficient system for coupling multiple home networks.

Brief Summary Text (11):
In accordance with the present invention, a system and method are disclosed for coupling multiple home networks. The invention includes a first copper wire network, a second copper wire network, and a high pass coupler between the first and second copper wire networks. The high pass coupler is configured to transfer data signals between the first and second copper wire networks, the data signals having frequencies greater than a maximum plain old telephone service signal frequency. The data signals typically include signals in accordance with the Home Phoneline Networking Alliance (HPNA) standard, and may also include broadband Internet access signals.

Brief Summary Text (12):
In one embodiment, the high pass coupler is implemented in a residential gateway device disposed between the first and second copper wire networks. The residential gateway device includes an ADSL modem for providing broadband Internet access to all of the devices in the first and second copper wire networks. The high pass coupler transfers HPNA signals and/or broadband Internet access signals, but blocks the transfer of Plain Old Telephone Service (POTS), or voice-band, signals.

Brief Summary Text (14):
The present invention advantageously allows devices on the second copper wire network to access the Internet via the broadband Internet connection established on the first copper wire network. The present invention also allows devices on one of the copper wire networks to share resources with devices on the other copper wire network, including peripheral devices such as printers and scanners. The present invention advantageously allows this sharing of resources without interrupting regular telephone service on both copper wire networks by preventing low frequency signal cross-talk between the first and second copper wire networks. The present invention blocks transfer of low frequency POTS, or voice-band, signals between the first and second copper wire networks. Therefore, the present invention efficiently and effectively implements coupling of multiple home networks.

Drawing Description Text (2):
FIG. 1 is a block diagram for one embodiment of a home network system;

Drawing Description Text (4):
FIG. 3 is a block diagram for one embodiment of a home network system, according to the present invention;

Drawing Description Text (6):
FIG. 5 is a block diagram for another embodiment of a home network system, according to the present invention;

Detailed Description Text (3):
Referring now to FIG. 1, a block diagram for one embodiment of a home network

system 100 is shown. A home 106 receives traditional telephone service (POTS) and broadband Internet service from a central office 102 via line 1. In the FIG. 1 embodiment, the Internet service is provided using Asynchronous Digital Subscriber Line (ADSL) technology; however, other broadband Internet access solutions, such as SDSL and HDSL, are within the scope of the present invention. Home 106 also receives traditional telephone service (POTS) from a central office 104 via line 2. Although two separate central offices are shown in FIG. 1, home 106 may receive services via line 1 and line 2 from a single central office.

Detailed Description Text (4):
A home network 140 includes, but is not limited to, a splitter 112, a POTS line 146, an ADSL line 144, an ADSL modem 110, a PC 114, a facsimile machine (fax) 116, a telephone (tel) 120, and a PC 118. Home network 140 may also include other electronic devices such as printers and scanners.

Detailed Description Text (6):
A second home network 142 includes, but is not limited to, line 2, a telephone 122, a PC 124, a PC 126, a fax 128, and a telephone 130. Home network 142 may also include other electronic devices such as printers and scanners. PC 124 and PC 126 each include a HPNA interface card so that these devices may share data across network 142. Telephone 122, fax 128, and telephone 130 each may include a low-pass filter so that these devices only receive POTS signals from network 142.

Detailed Description Text (8):
Referring now to FIG. 2, a graph of exemplary power spectrums and corresponding frequency ranges is shown, according to one embodiment of the present invention. Three signals that may be present on a home network include a POTS signal, an ADSL signal, and a HPNA signal. These three signals occupy separate frequency ranges. As shown in FIG. 2, a POTS spectrum 212 occupies frequencies from approximately 20 Hz to 4 kHz. An ADSL spectrum 214 occupies frequencies from approximately 25 kHz to 1 MHz. A HPNA spectrum 216 occupies frequencies from approximately 5 MHz to 10 MHz.

Detailed Description Text (10):
Referring now to FIG. 3, a block diagram for one embodiment of a home network system 300 is shown, according to the present invention. In the FIG. 3 embodiment, line 1 and line 2 enter home 306 at an ADSL gateway 312, which is a residential gateway device. Network 340 and network 342 may exchange data via ADSL gateway 312. Fax 316 and telephone 318 see network 340 simply as a single telephone line (line 1), and telephone 322, fax 328, and telephone 330 see network 342 as a single telephone line (line 2). The POTS devices each may contain a low-pass filter to prevent the ADSL signals and HPNA data signals from interfering with their operation.

Detailed Description Text (12):
Referring now to FIG. 4, a block diagram for one embodiment of the ADSL gateway 312 of FIG. 3 is shown, according to the present invention. ADSL gateway 312 includes, but is not limited to, an ADSL modem 412, a CPU 414, a HPNA interface 416, a media access control and physical layer (MAC PHY) 418, and a high pass coupler, or filter, 420.

Detailed Description Text (13):
ADSL modem 412 demodulates an ADSL signal from central office 102, and sends the demodulated digital data to CPU 414. To send data out to the Internet, CPU 414 sends digital data to ADSL modem 412, and ADSL modem 412 modulates the data into an ADSL signal and sends the modulated signal to central office 102 via line 1. HPNA interface 416 modulates and demodulates HPNA signals for data exchange between ADSL gateway 312 and other home network devices on network 340 and network 342.

Detailed Description Text (14):
High pass coupler 420 couples line 1 and line 2, which effectively couples network

340 and network 342. High pass coupler 420 allows high frequency signals such as HPNA signals and/or ADSL signals to pass between network 340 (FIG. 3) and network 342 in home 306, thus creating one integrated home network.

Detailed Description Text (17):
Referring now to FIG. 5, a block diagram for one embodiment of a home network system 500 is shown, according to the present invention. In the FIG. 5 embodiment, a home network 540 receives traditional telephone service from central office 102 via line 1, and a home network 542 receives traditional telephone service from central office 104 via line 2. Network 540 and network 542 are coupled by a network coupler 510. Network coupler 510 couples network 540 and network 542 to create an integrated home network. Network coupler 510 allows non-POTS home-networking devices on network 540, such as PC 514, and non-POTS home-networking devices on network 542, such as a printer 526, to exchange data via HPNA signals. Network coupler 510 also blocks the exchange of low frequency signals between POTS devices such as telephones 520 and 530 across network 540 and network 542; that is, network coupler 510 prevents cross-talk of POTS signals between line 1 and line 2.

Detailed Description Text (18):
Network coupler 510 may also be utilized in home network systems having an ADSL gateway on one of the telephone networks, where the ADSL gateway is a different embodiment than ADSL gateway 312 of FIG. 3. Network coupler 510 may allow the exchange of ADSL signals, as well as HPNA signals, between non-POTS devices on the integrated home network. The contents and functionality of network coupler 510 are further discussed below in conjunction with FIG. 6.

Detailed Description Text (19):
Referring now to FIG. 6, a block diagram for one embodiment of the network coupler 510 of FIG. 5 is shown, according to the present invention. Network coupler 510 may couple network 540 and network 542 at any point in home 506 where access to both networks is available, for example a wall jack with connections to both networks. Network coupler 510 includes a high pass coupler 610 between path 620 and path 622. Path 620 is connected to network 540 at a RJ11 jack 616, and path 622 is connected to network 542 at a RJ11 jack 618. Thus network coupler 510 couples network 540 and network 542, passing high-frequency signals, such as HPNA signals, but blocking low-frequency POTS signals. Thus non-POTS devices on network 540 and network 542 may exchange data while preventing cross-talk and operational interference (e.g., on-hook and off-hook conditions) between POTS devices on the networks.

Detailed Description Text (21):
Referring now to FIG. 7, a diagram for one embodiment of the high pass coupler 610 of FIG. 6 is shown, according to the present invention. High pass coupler 610 may also be implemented in ADSL gateway 312 (as high pass coupler 420) as described above in conjunction with FIG. 4. High pass coupler 610 includes inductance coils (windings) 712 and 714 that couple the signals on line 1 and line 2. For example, a HPNA signal passing through coil 712 will be induced in coil 714 according to well-known principles. Coil 712 and coil 714 are identical so that the induced signals are identical to the original signals. Thus, a high frequency data signal may be exchanged between line 1 and line 2 with no modification.

Detailed Description Text (23):
A capacitor is disposed in the middle of each inductance coil 712 and 714 to create a high pass filter according-to well known principles for blocking the induction of POTS signals. Both capacitors preferably have the same capacitance value. Since the POTS frequency range is a significant distance away from the ADSL signal frequency range and the HPNA signal frequency range (see FIG. 2), the coupling inductance value and each capacitance value in high pass coupler 610 need not be determined with great precision. The component values of high pass coupler 610 may vary for networks that support broadband Internet access other than ADSL, and for networks that do not support any type of broadband Internet access.

Detailed Description Text (26):
Next, in step 814, high pass coupler 610 permits transfer of high frequency data signals between the multiple copper wire networks. The high frequency data signals have frequencies that are higher than a maximum voice-band frequency, typically about 4 kHz. The data signals may include DSL or other broadband Internet access signals, and HPNA home networking signals. In step 816, high pass coupler 610 prevents transfer of POTS, or voice-band, signals between the multiple copper wire networks. Preventing the transfer of POTS signals allows POTS devices on one of the multiple networks to operate without interference from POTS devices on another of the multiple networks. Thus, the method of the present invention effectively and efficiently couples multiple home networks.

CLAIMS:

11. A system for coupling multiple home networks, comprising: a first copper telephone wire network operable to carry voice signals and Internet data, wherein the first telephone wire network couples to a telephone; a second copper telephone wire network; and a high pass coupler having a first transformer and a first capacitor configured to exchange data between said first and second copper telephone wire networks, while preventing exchange of plain old telephone service signals between said first and second copper telephone wire networks.

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L9: Entry 1 of 5 File: USPT Jun 8, 2004

DOCUMENT-IDENTIFIER: US 6748080 B2
TITLE: Apparatus for entitling remote client devices

Brief Summary Text (6):
The DSCT and the subscriber devices are sometimes coupled together via a local area network, which can be wired or wireless or a combination thereof. Wired communication paths include, among others, HomePNA 1 and 2, which uses home telephone lines and which has a data transfer rate of up to 1 and 10 Mbps, respectively, HomePlug, which has a data transfer rate of 14 Mbps, and Ethernet. Wired communication has the disadvantage of requiring that a wire extend from the DSCT to the subscriber device, which in an existing subscriber residence may entail retrofitting the residence, and that can be expensive. Therefore, it is frequently desirable to couple subscriber devices to the DSCT using wireless communication, especially with the proliferation of portable computing devices. Wireless communication allows the subscriber to easily move his or her portable computing device, smart appliance, etc., or client-devices, within his or her local wireless network while remaining connected to the subscriber network through the subscriber's DSCT and also eliminating the need to wire multiple rooms with coaxial cable or other wires. Wireless technologies have advanced so that they enable data to be pumped quickly through a wireless connection. The Institute for Electronics and Electrical Engineers (IEEE) 802.11b standard enables the user to transfer data at a rate approximately equal to Ethernet data rates, about 10 Mbps. As such it is sometimes called wireless Ethernet. IEEE 802.11a enables transfer rates of up to 54 Mbps. Industry collaboration, Bluetooth 2.0 enables users to transfer data at a rate of about 10 Mbps. HomeRF 2.0 is another industry collaboration, backed by a few of the same companies promoting the Bluetooth standard, and like Bluetooth 2.0, has a maximum data transfer rate of about 10 Mbps.

Detailed Description Text (13):
In a digital format, a program is encoded into its elementary parts, such as video, audio, etc. Frequently, a program can use more than one audio track so that the program can be heard in several different languages such as English, French, or German, and each audio track is an elementary stream of the program. The program is further encoded so that the elementary parts are packetized into multiple packets. MPEG is a common format used for packetizing a digital program. A packet identifier (PID) identifies each of the packets, and all of the packets that make up an elementary part of the program have the same PID values. For example, all of the video packets might have the PID value of 251 and, all of the English audio packets might have a PID value of 255, etc.

Detailed Description Text (36):
The headend 102 generally includes a plurality of receivers 218 that are each associated with a content source. Generally, the content is transmitted from the receivers 218 in the form of transport stream 240. MPEG encoders, such as encoder 220, are included for digitally encoding content such as local programming or a feed from a video camera. Typically, the encoder 220 produces a variable bit rate transport stream. Prior to being modulated, some of the signals may require additional processing, such as signal multiplexing, which is preformed by multiplexer 222.

Detailed Description Text (39):
The various inputs into the headend 102 are then combined with the other information, which is specific to the DBDS 100, such as local programming and control information. The headend 102 includes a multi-transport stream receiver-transmitter 228, which receives the plurality of transport streams 240 and transmits a plurality of transport streams 242. In the preferred embodiment, the multi-transport stream receiver-transmitter 228 includes a plurality of modulators, such as, but not limited to, Quadrature Amplitude Modulation (QAM) modulators, that convert the received transport streams 240 into modulated output signals suitable for transmission over transmission medium 280.

Detailed Description Text (40):
In the preferred embodiment, the output transport streams 242 have a bandwidth of 6 MHz centered upon a frequency that is predetermined for each transport stream 242. The frequency for a given transport stream 242 is chosen such that the given transport stream will not be combined with another transport stream at the same frequency. In other words, only transport streams that are modulated at different frequencies can be combined, and therefore, the frequencies of transport streams 242A-D must be different from each other because combiner 230A combines them. The transport streams 242 from the multi-transport stream receiver-transmitters 228 are combined, using equipment such as combiner 230, for input into the transmission medium 150, and the combined signals are sent via the in-band delivery path 254 to subscriber locations 108.

Detailed Description Text (51):
In the preferred embodiment, the multi-transport stream receiver-transmitter 228 is adapted to encrypt content prior to modulating and transmitting the content. Typically, the content is encrypted using a cryptographic algorithm such as the Data Encryption Standard (DES) or triple DES (3DES), Digital Video Broadcasting (DVB) Common Scrambling or other cryptographic algorithms or techniques known to those skilled in the art. The multi-transport stream receiver-transmitter 228 receives instructions from the control system 232 regarding the processing of programs included in the input transport streams 240. Sometimes the input transport streams 240 include programs that are not transmitted downstream, and in that case the control system 232 instructs the multi-transport stream receiver-transmitter 240 to filter out those programs. Based upon the instructions received from the control system 232, the multi-transport stream receiver-transmitter 228 encrypts some or all of the programs included in the input transport streams 240 and then includes the encrypted programs in the output transport streams 242. Some of the programs included in input transport stream 240 do not need to be encrypted, and in that case the control system 232 instructs the multi-transport stream transmitter-receiver 228 to transmit those programs without encryption. The multi-transport streams receiver-transmitter 228 sends the DSCTs 110 the information used to decrypt the encrypted program. It is to be understood that for the purposes of this disclosure a "program" extends beyond a conventional television program and that it includes video, audio, video-audio programming and other forms of services and digitized content. "Entitled" DSCTs 110 are allowed to use the decryption information to decrypt encrypted content, details of which are provided hereinbelow.

Detailed Description Text (60):
The DSCT 110 includes a user-interface 316, such as an infrared receiver, through which the user enters commands, such as selecting a "user-channel" for viewing a selected service instance. It is important to remember that a "user-channel" is not a conventional television channel. A conventional television channel in a cable television system is a 6 MHz band (which carries one analog program) centered on a particular frequency. However, today a "user-channel" conceptively corresponds to a service instance or a string of service instances in the preferred embodiment of the present invention. Frequently, multiple service instances are multiplexed together in a transport stream, and the transport stream is RF modulated and

transmitted in a 6 MHz band. Thus, a single 6 MHz band carries multiple service instances or user-channels. When a user changes programs or service instances by selecting a new user-channel, the new user-channel and the old user-channel might be carried in the same 6 MHz band or in different 6 MHz bands. So it is important to distinguish between a conventional channel and a user-channel. It is to be understood user-channel represents one type of communication channel. Communication channels include, but are not limited to, communication signals that are separated by: frequency, which is generally referred to as frequency-division multiplexing (FDM); time, which is generally referred to as time-division multiplexing (TDM); and code, which is generally referred to as code-division multiplexing (CDM).

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US 20040087214A1

(19) United States
(12) Patent Application Publication (10) Pub. No.: US 2004/0087214 A1
Cho (43) Pub. Date: May 6, 2004

(54) NETWORK ADAPTER

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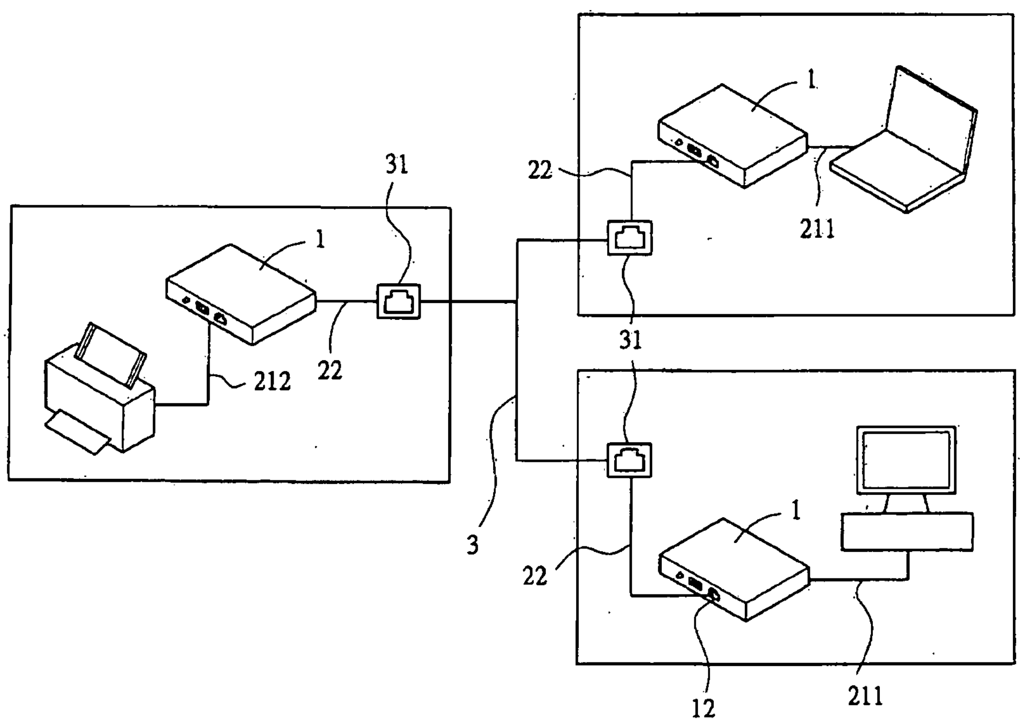
(57) ABSTRACT

A network adapter device such as a modulation bridge is provided for establishing a home network. The device comprises a modulation bridge including a control chip assembly complied with HomePlug, a plurality of device ports wherein one is adapted to connect to a computer via a network line and the other one is adapted to connect to a peripheral via a USB line, a coaxial cable jack, a modular telephone jack, and a power cord jack. Thus, the invention can connect to a power cord, telephone line cord, or coaxial cable for effecting a data transmission between a computer and a peripheral or between computers in the home network.



L12: Entry 3 of 22 File: USPT Mar 1, 2005

DOCUMENT-IDENTIFIER: US 6862353 B2
TITLE: System and method for providing power over a home phone line network

Parent Case Text (3):
U.S. Pat. Ser. No. 60/199,732, entitled "HPNA Powering Concept," filed Apr. 24, 2000, by Rabenko et al., (still pending) (incorporated by reference in its entirety herein).

Brief Summary Text (6):
Home networking is becoming increasingly popular. This increased popularity is due, in part, to an increase in the number of households with more than one personal computer (PC). According to the International Data Corporation (IDC), more than 20 million U.S. households have more than one computer. Additionally, market research indicates that consumers who currently own PCs are also the same consumers buying the majority of new computers. As a result, multi-computer households are becoming increasingly common. Home networks provide a variety of benefits to such multi-computer households. For example, home networks permit the users of multiple PCs to share a common printer, share files such as images, spreadsheets and documents, and access the Internet via a common network connection.

Brief Summary Text (7):
In addition to PCs, a wide variety of other devices may be attached to a home network including, but not limited to, PC peripheral devices, broadband media players, and telecommunication devices. For example, televisions and audio equipment can reside on a home network for receiving video and audio content over the Internet via a dial-up, cable, xDSL, or wireless connection. Additionally, VoIP (Voice over Internet Protocol) telephones can be connected to the home network for enabling Internet telephony via an external network connection.

Brief Summary Text (8):
Conventional home network types include home phone line, home power line, Ethernet, wireless connections, or some combination of the above. Home phone line networking is considered advantageous because it is relatively inexpensive and easy to install. Indeed, as the vast majority of U.S. homes include at least one phone line (and a majority of U.S. homes include two phone lines), home phone line networking typically does not require the installation of any additional wiring in the home.

Brief Summary Text (9):
Home phone line networking is often referred to as HomePNA or HPNA because it is based on specifications developed by the Home Phoneline Networking Alliance. The alliance is a consortium of networking technology companies that have created a phone line standard for the networking industry. HPNA uses a method known as Frequency Division Multiplexing (FDM) to permit voice and data to travel on the same phone line simultaneously without interfering with each other. HPNA 1.0, the original version of the standard, operates at 1 Mbps. The current specification, HPNA 2.0, operates at a faster 10 Mbps.

Brief Summary Text (14):
Finally, home phone line networks by definition must be capable of supporting a variety of services for transporting both voice and data. Accordingly, the system

and method for providing power over a home phone line network should be interoperable with other services that are delivered over the home phone line network, such as POTS and HPNA.

Brief Summary Text (22):
Another benefit of the invention is that it permits power to be supplied to one or more devices over a home phone line network in a manner that is interoperable with POTS and HPNA.

Drawing Description Text (4):
FIG. 2 illustrates an exemplary home network system in which embodiments of the present invention may operate.

Detailed Description Text (9):
The CMTS 110 is an element at the cable headend that controls the upstream and downstream transfer of data between itself and the cable modem 106 (within the embedded MTA device 102), as well as any other cable modems to which it may be attached by means of the HFC/cable network 108. The CMTS 110 modulates and terminates RF signals going to and coming from the HFC/cable network 108, and bridges these to a more generic type of data transport to connect with a network backbone (not shown).

Detailed Description Text (16):
2. Exemplary Home Network System

Detailed Description Text (17):
FIG. 2 illustrates an exemplary home network system 200 in which embodiments of the present invention may operate. The exemplary home network system 200 includes a home phone line network 202 and several network-attached devices including a residential gateway 204, a POTS phone 206, a first HPNA adapter 208, a first telephony device 210, a second HPNA adaptor 212, a second telephony device 214, and an HPNA phone 216. It will be appreciated that other customer premises equipment may be attached to the home phone line network 202. Such equipment may include one or more PCs, PC peripherals, PC-controlled appliances, audio and video equipment, and/or other electronic devices.

Detailed Description Text (18):
In the exemplary home network system 200, the home phone line network 202 provides the physical connection between the residential gateway 204 and the other network-attached devices shown in FIG. 2. In embodiments, the home phone line network 202 comprises a twisted copper wire pair as conventionally used in providing residential phone service. In the exemplary home network system 200, the home phone line network 202 supports at least two-well known protocols for the delivery of in-home services. The first protocol delivers POTS as described in Bellcore.RTM. (now Telcordia.TM.) Technical Reference TR-NWT-000057 "Functional Criteria for Digital Loop Carrier Systems." The second protocol is HPNA as described in the Version 2.0 specification.

Detailed Description Text (19):
The POTS phone 206 represents a traditional POTS telephone that is connected to the residential gateway 204 for telephone service. In accordance with the example home network system 200, the existing premises wiring is disconnected from the telephone company's CO that supplies normal POTS and xDSL services. Instead, POTS service at the customer premises is provided by subscriber line interface circuits (SLICs) within the residential gateway 204.

Detailed Description Text (21):
Two additional telephony devices, first telephony device 210 and second telephony device 214, are connected to the home phone line network 202 via the first HPNA adapter 208 and the second HPNA adapter 212, respectively. In the example home

network system 200, the first telephony device 210 and the second telephony device 214 comprise standard POTS devices that could be used to receive service on a traditional POTS connection. For example, the first telephony device 210 may be a standard POTS phone and the second telephony device 214 may be a fax machine. The HPNA adapters 208 and 212 permit these telephony devices to communicate over the home phone line network 202 to an HPNA interface within the residential gateway 204 using HPNA protocols. In this example, the HPNA adapters 208 and 212 provide two additional phone numbers that are different from the phone number assigned to the POTS phone 206 described above.

Detailed Description Text (22):
The HPNA phone 216 shown in FIG. 2 is a telephone that integrates the function of an HPNA adapter and a telephone. As such, the HPNA phone 216 will look and operate just like any traditional telephone but use an HPNA interface to accomplish the voice transport and signaling function instead of a POTS interface. In this example, the HPNA phone 216 provides another additional phone number that is different from the phone number assigned to the POTS phone 206 described above.

Detailed Description Text (24):
The residential gateway 204 includes an embedded MTA device 218, an HPNA transceiver 220, a POTS interface 222, and a power source 224.

Detailed Description Text (26):
The HPNA transceiver 220 within the residential gateway 202 comprises a front-end for converting analog HPNA signals on the home phone line network 202 into a digital format for processing by an HPNA interface within the embedded MTA device 218, and, conversely, for converting digital signals from an HPNA interface within the embedded MTA device 218 into analog HPNA signals for transmission to devices on the home phone line network 202.

Detailed Description Text (28):
The power source 224 supplies power to one or more devices on the home phone line network 202, such as the first HPNA adapter 208, the second HPNA adapter 212, and/or the HPNA phone 216. Like the embedded MTA device 218, the power source 224 is itself powered by a raw rectified AC source voltage from the external HFC/cable network. The manner by which the power source 224 supplies power to devices on the home phone line network will be described in more detail below.

Detailed Description Text (30):
FIG. 3 illustrates in more detail the residential gateway 204 of FIG. 2 as well as its functional sub-components. As discussed in regard to FIG. 2, the residential gateway 204 of FIG. 3 includes an embedded MTA device 218, an HPNA transceiver 220, a POTS interface 222, and a power source 224.

Detailed Description Text (31):
The embedded MTA device 218 and the HPNA transceiver 220 have been described in reference to FIG. 2, above.

Detailed Description Text (33):
The power source 224 generates a power signal for providing power to one or more devices on the home phone line network. For example, the power source 202 may be used to provide power to the first HPNA adapter 208, the second HPNA adapter 212, and/or the HPNA phone 216 depicted in FIG. 2. The power source 224 is itself powered by the raw rectified AC source voltage from the external HFC/cable network also used to power the embedded MTA device 218. As shown in FIG. 3, the power source 224 includes an AC signal generator 302 and a band pass filter 304. In alternate embodiments, the power source 224 is powered by a different external source, such as a xDSL line, or is powered by a local source such as a battery or residential AC utility power.

Detailed Description Text (34):
The AC signal generator 302 generates a high level AC power signal for providing power to devices on the home phone line network 202. Embodiments of the present invention utilize an AC signal, as opposed to a DC signal, to avoid interfering with POTS service on the home phone line network 202. Conventional POTS service entails providing DC power to telephones. The typical DC feed for off-hook domestic phones is roughly 25 mA. Where POTS service is provided by the telephone company's CO, line card circuitry at the CO limits the amount of feed current to the phone. However, in the home network system 200, the POTS interface 222 in the residential gateway 204 cannot distinguish the DC current feed for an off-hook phone from the DC current drawn by an HPNA adapter (e.g., HPNA adapter 208). Therefore, under fault conditions which result in high power draw and dissipation, the current cannot be properly limited by circuitry in the residential gateway 204. By utilizing an AC powered solution, embodiments of the present invention avoid this problem.

Detailed Description Text (35):
Where an AC signal is used, several issues are relevant. Both the spectral centering of the fundamental AC signal and its harmonics are of primary concern because of potential interference with the POTS voice band and the HPNA band on the shared phone line.

Detailed Description Text (36):
In particular, the power signal must not interfere with the POTS voice band, (<4 Khz) or metering bands (12 Khz/16 Khz) for international applications, as well as the HPNA band (4 MHz<f<10 MHz). To ensure that the AC signal generated by the AC signal generator 302 does not interfere with these bands, embodiments of the present invention utilize an AC signal generator 302 that generates an AC signal centered somewhere above 20 Khz and below approximately 200 Khz. Placing the AC power spectrum at a very high frequency above the HPNA band is less desirable because it reduces the power delivery capability of the transmission system. This is because losses in the cable and radiated emissions (radio frequency interference) are directly proportional to the frequency.

Detailed Description Text (37):
It is also critical that there are no subharmonics of the source frequency that would interfere with the POTS voice band or HPNA band. With AC signals that are non-sinusoidal, harmonics may appear on the line that can disrupt voice or data communications. As such, what is desired is a spectrally clean signal with low harmonics. In order to achieve this, the AC signal generated by the AC signal generator 302 is received by the band pass 304 which filters out undesired noise and harmonics before placing the signal on the home phone line network 202.

Detailed Description Text (39):
A resonant mode power supply is similar in design to a class D amplifier. However, unlike a class D amplifier, the resonant mode supply can generate an AC waveform directly by exciting a resonant tank circuit that will oscillate at the desired fundamental frequency. Since this topology generates the AC signal directly, harmonic content is reduced, thus providing a cleaner waveform. For example, the harmonics from the power source 224 into a resistive load on the home phone line network should be well below the acceptable narrow-band immunity limits specified for an HPNA 2.0 receiver.

Detailed Description Text (41):
In a further alternative embodiment, the AC signal generator 302 may comprise a class D amplifier. A class D amplifier is a switched mode topology in which the AC waveform is created by modulating the duty cycle of the switching waveform and then filtering out the high frequencies. A class D type of amplifier is highly efficient. However, the complexity of this design may limit it's usefulness due to a potential increase in the cost of the design. Also, a class D amplifier may be

considered undesirable because it utilizes a switching frequency that must be several times the output frequency, which means that its lower order harmonics may interfere with the HPNA band.

Detailed Description Text (42):
FIG. 5 presents a chart 500 that depicts available spectrum use of a phone line by POTS, HPNA and a power source in accordance with embodiments of the present invention. As can be seen in the chart 500, the POTS service, represented by line 502, dominates the lower frequencies, while the HPNA service, marked by the line 512, dominates the higher frequencies. Thus, in accordance with embodiments of the present invention, the desired power signal and its harmonics will not interfere with either of these bands. Here, the AC power signal, marked as the line 504, is centered at approximately 150 kHz. In addition, the harmonics of the AC power signal are also marked as lines 506, 508 and 510. As shown in the chart 500, these harmonic signals approach the HPNA band, but will not interfere with the HPNA band when properly attenuated. Proper attenuation may entail additional filtering to comb off higher frequency harmonics that may interfere with HPNA.

Detailed Description Text (43):
In addition to ensuring spectral compatibility with POTS and HPNA, another primary design constraint is the need for high efficiency due to the limited power available from the HFC/cable network. Since a high efficiency system is required due to limited network power, it is desired to minimize the power loss in the wiring. Since the loss may be defined as I.sup.2 R, the maximum efficiency with respect to the transmission of power is obtained by maximizing the voltage and minimizing the current. However, UL 1950 restricts non-hazardous safety voltage levels for Safety Extra Low Voltage (SELV) circuits to less than 42.4 V peak (30 Vrms for a sinusoid). Thus, in order to maximize the voltage while complying with UL 1950 limits, embodiments of the present invention utilize a source voltage level below 30 Vrms. In embodiments, a source voltage of 28 Vrms is used in order to allow for a margin of error.

Detailed Description Text (44):
FIG. 4A depicts an HPNA adapter 400 in accordance with embodiments of the present invention. The HPNA adapter 400 is analogous to either the first HPNA adapter 208 or the second HPNA adapter 212 described in regard to FIG. 2, above. The HPNA adapter 400 is a media adapter that converts voice communications from POTS to HPNA and, conversely, from HPNA to POTS, so that standard POTS telephony devices may be connected to the home phone line network 202 for VoIP communication.

Detailed Description Text (45):
As shown in FIG. 4A, the HPNA adapter 400 includes a band pass filter 402, an AC/DC converter 404, a POTS interface 406, HPNA logic 408, and an HPNA transceiver 410.

Detailed Description Text (46):
Telephone communication via the HPNA adapter 400 is carried out as follows. Voice signals are received from a POTS telephony device by the POTS interface 406. These signals are passed to the HPNA logic 408 which converts them into digital signals consistent with the HPNA protocol. The digital signals are then passed to the HPNA transceiver 410, which converts them into analog HPNA signals for transmission over the home phone line network 202 to the residential gateway 204. At the residential gateway 204, the HPNA signals are converted into packets for transmission over the IP network to the cable headend.

Detailed Description Text (47):
Conversely, voice packets received from the cable headend are converted into HPNA signals at the residential gateway 204 and passed to the HPNA adapter 400 via the home phone line network 202. The analog HPNA signals are received by the HPNA transceiver 410, which converts them into digital HPNA signals for processing by the HPNA logic 408. The HPNA logic 408 converts the digital HPNA signals into voice

signals consistent with POTS and passes them to the POTS interface 406, where they are relayed to the POTS telephone device attached to the HPNA adapter 400.

Detailed Description Text (48):
In embodiments of the present invention, the HPNA adapter 400 is powered by the AC power signal generated by the power source 224 in the residential gateway 204, as discussed above. The AC power signal is received by the HPNA adapter 400 over the home phone line network 202. The AC/DC converter 404 converts the AC signal into DC power that is used to power the HPNA adapter 400.

Detailed Description Text (49):
The AC/DC converter 404 may be any conventional circuit for converting an AC signal into a DC signal. In embodiments, the AC/DC converter 404 includes a diode full-wave bridge and filter capacitor, which is inherently nonlinear and will thus introduce harmonic distortion on the phone line that may interfere with HPNA signals even if powered by a pure sine wave source. Accordingly, the band pass filter 402 operates to prevent the introduction of undesired harmonics created by the AC/DC converter onto the home phone line network 202.

Detailed Description Text (50):
In particular, the band pass filter 402 performs at least two functions. First, it forces the power factor of the AC/DC converter loading to be virtually 1, thereby restricting the AC power signal passing through it to be at the fundamental frequency only and the load voltage and current to be in phase, yielding 1 Watt per Volt-Amp. As a result, the non-linearities of the rectification of the sine wave signal by the AC/DC converter are not passed through to the phone line. Second, the power circuit, which comprises the band pass filter 402 and the AC/DC converter 404, must not load the line in the POTS and HPNA bands and must coexist with the existing impedance masks defined by those standards. Therefore, the band pass filter 402 and the AC/DC converter 404 present a high load impedance in both bands.

Detailed Description Text (51):
FIG. 4B illustrates an HPNA phone 412 in accordance with embodiments of the present invention. The HPNA phone 412 is analogous to the HPNA phone 216 described in regard to FIG. 2, above. The HPNA phone 412 is similar to the HPNA adapter 400, except that no POTS interface is required for communication. Instead, the HPNA logic 414 performs the necessary voice transport and signaling functions required for Internet telephony. Also, the HPNA phone 412 incorporates a user interface 416, which may comprise a telephone handset, headset, or microphone/speaker for sending and receiving voice signals to and from a local user, that interfaces to the HPNA logic. As shown in FIG. 4B, the powering logic for the HPNA phone 412 is essentially the same as that used for the HPNA adapter 400. This logic comprises a band pass filter 402 and AC/DC converter 404 that operate in the same general manner described in regard to the HPNA adapter 400.

Detailed Description Text (52):
FIG. 6 depicts a flowchart 600 of a method for powering devices over a home phone line network in accordance with embodiments of the present invention. The invention, however, is not limited to the description provided by the flowchart 600. Rather, it will be apparent to persons skilled in the art from the teachings provided herein that other functional flows are within the scope and spirit of the present invention. The flowchart 600 will be described with continued reference to the residential gateway 204 of FIG. 3, the HPNA adapter 400 of FIG. 4A and the HPNA phone 412 of FIG. 4B.

Detailed Description Text (55):
At step 606, the AC signal generated by the AC signal generator 302 is received by the band pass filter 304, which filters the AC signal to remove undesired harmonics. For example, the band pass filter 304 filters the AC signal to remove

undesired harmonics that could interfere with HPNA signals on the home phone line network 202.

Detailed Description Text (57):
At step 610, a device on the home phone line network 202, such as the HPNA adapter 400 or the HPNA phone 412, receives the filtered AC signal from the network.

Detailed Description Text (58):
At step 612, the band pass filter 402 within the HPNA adapter 400 or the HPNA phone 412 passes the filtered AC signal to the AC/DC converter 404. The band pass filter 402 also operates to prevent the introduction of undesired harmonics created by a non-linear source such as the AC/DC converter 404 onto the home phone line network 202. For example, the band pass filter 402 prevents the introduction of undesired harmonics created by the AC/DC converter that could interfere with HPNA signals on the home phone line network 202.

Detailed Description Text (59):
At step 614, the AC/DC converter 404 within the HPNA adapter 400 or the HPNA phone 412 receives the filtered AC signal from the band pass filter 402 and converts it into a DC signal for powering the HPNA adapter 400 or the HPNA phone 412.

Detailed Description Text (61):
While various embodiments of the present invention have been described above, it should be understood that they have been presented by way of example only, and not limitation. For example, the present invention may be implemented on a home phone line network that uses a protocol other than HPNA for modulating data traffic. Furthermore, the present invention is not limited to delivering power only to telephony devices, such as adapters and phones, but may be used to power any type of electronic device that can reside on a home phone line network. Also, the invention need not be powered by the HFC/cable network, but instead may be powered by other external sources, such as an xDSL line, or local sources such as a battery or adapter that operates off of the residential AC power supply.

CLAIMS:

1. A system for supplying power over a home phone line network in a manner that is interoperable with Plain Old Telephone Service (POTS) and Home Phoneline Network Alliance (HPNA) services operating on the same home phone line network, comprising: a power source coupled to the home phone line network, wherein said power source comprises: an AC signal generator; and a band pass filter; wherein said AC signal generator generates an AC signal with a fundamental frequency spectrally centered between 20 kHz and 200 kHz, and wherein said band pass filter removes undesired harmonics from said AC signal to generate a filtered AC signal for transmission on the home phone line network for powering one or more devices on the home phone line network.

10. A system for supplying power over a home phone line network in a manner that is interoperable with Plain Old Telephone Service (POTS) and Home Phoneline Network Alliance (HPNA) services operating on the same home phone line network, comprising: (a) a power supply coupled to the home phone line network, wherein said power supply comprises: an AC signal generator; and a first band pass filter; and (b) a telephony device coupled to the home phone line network, wherein said telephony device comprises: a second band pass filter; and an AC/DC converter; wherein said AC signal generator generates an AC signal with a fundamental frequency spectrally centered between 20 kHz and 200 kHz, wherein said first band pass filter removes undesired harmonics from said AC signal to generate a filtered AC signal for transmission on the home phone line network, wherein said second band pass filter receives said filtered AC signal from the home phone line network and passes it to said AC/DC converter, wherein said AC/DC converter converts said filtered AC signal into a DC signal for powering said telephony device, and wherein said second band

pass filter prevents the introduction of undesired harmonics onto the home phone line network from said AC/DC convener.

19. A system for supplying power over a home phone line network in a manner that is interoperable with Plain Old Telephone Service (POTS) and Home Phoneline Network Alliance (HPNA) services operating over the same home phone line network, comprising: (a) a power supply coupled to the home phone line network, wherein said power supply comprises: an AC signal generator; and a first band pass filter; and (b) a plurality of electronic devices coupled to the home phone line network, wherein each of said plurality of electronic devices comprises: a second band pass filter; and an AC/DC converter; wherein said AC signal generator generates an AC signal with a fundamental frequency spectrally centered between 20 kHz and 200 kHz, wherein said first band pass filter removes undesired harmonics from said AC signal to generate a filtered AC signal for transmission on the home phone line network, wherein each of said second band pass filters receives said filtered AC signal from the home phone line network and passes said filtered AC signal to a corresponding AC/DC converter, wherein each of said corresponding AC/DC converters converts said filtered AC signal into a DC signal for powering each of said plurality of electronic devices, and wherein each of said second band pass filters prevents the introduction of undesired harmonics onto the home phone line network from said corresponding AC/DC converter.

20. A residential gateway for providing power over a home phone line network in a manner that is interoperable with Plain Old Telephone Service (POTS) and Home Phoneline Network Alliance (HPNA) services operating on the same home phone line network, comprising: an HPNA interface; a POTS interface; and a power supply; wherein each of said HPNA interface, said POTS interface and said power supply are coupled to the home phone line network, wherein said HPNA interface transmits analog data signals over the home phone line network, wherein said POTS interface transmits analog voice signals over the home phone line network, and wherein said power supply supplies an AC power signal with a fundamental frequency spectrally centered between 20 kHz and 200 kHz over the home phone line network that does not interfere with said analog voice and data signals.

22. A method for supplying power over a home phone line network in a manner that is interoperable with Plain Old Telephone Service (POTS) and Home Phoneline Network Alliance (HPNA) services operating on the same home phone line network, comprising: generating an AC signal with a fundamental frequency spectrally centered between 20 kHz and 200 kHz; band pass filtering said AC signal to remove undesired harmonics to generate a filtered AC signal; and providing said filtered AC signal to the home phone line network.

24. A method for supplying power over a home phone line network network in a manner that is interoperable with Plain Old Telephone Service (POTS) and Home Phoneline Network Alliance (HPNA) services operating on the same home phone line network, comprising: generating an AC signal with a fundamental frequency spectrally centered between 20 kHz and 200 kHz; band pass filtering said AC signal to remove undesired harmonics, thereby generating a first filtered AC signal; providing said filtered AC signal over the home phone line network; receiving said filtered AC signal from the home phone line network; band pass filtering said filtered AC signal to prevent undesired harmonics from being passed to the home phone line network; and converting said filtered AC signal to a DC signal for powering an application.

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L12: Entry 5 of 22 File: USPT Dec 14, 2004

DOCUMENT-IDENTIFIER: US 6831975 B1
TITLE: Digital subscriber line (DSL) modem compatible with home networks

Abstract Text (1):
A cost-effective filter consuming low power and occupying minimal space. The filter may be used in a ADSL modem (or CPE) to filter the signal components other than the ADSL signals. A high pass filter first filters the low frequency components to attenuate (or remove) lower frequency components such as that caused by ADSL transmit echo signals and that used for voice transmission. The high pass filter may be modified by adding a few resistors to limit the voltages of the high frequency signals also. The output of the high pass filter is amplified and passed through a low pass filter to filter the high frequency components (HPNA included). Due to earlier filtering operation of the high pass filter, the signal can be amplified substantially before being sent to the low pass filter. The implementation of the low pass filter is simplified due to the prior amplification.

Brief Summary Text (3):
The present invention relates to modems used in telecommunications and more specifically to a DSL modem which is compatible with home networks such as those based on home phone networking alliance (HPNA) standard.

Brief Summary Text (5):
Digital subscriber line (DSL) technology is often used to provide high bandwidth connections to homes using local loops. Typically, each home contains what is commonly referred to as a customer premises equipment (CPE). The CPE may in turn contain (or interface with) a modem which receives (and transmits) signals representing digital data stream (a sequence of bits typically) encoded according to the ADSL specifications.

Brief Summary Text (8):
Accordingly, an ADSL modem (or an analog to digital converter (ADC) in the modem) is typically designed to sample a received signal in the 180 kHz -1.1 MHZ band, and the resulting samples may be analyzed to recover the data encoded according to ADSL specifications. Problems may be posed to the data recovery task when the telephone lines are shared for other purposes. As is well known, telephone lines are also used to provide connectivity between devices (such as computer systems) using specifications such as those developed by HPNA.

Brief Summary Text (9):
One problem resulting from the sharing of the telephone lines by home networking and DSL technologies, is that HPNA compatible transmissions are in the 4-10 MHZ band, and the signals in 4-10 MHZ band would alias into 180 KHZ -1.1 MHZ band. As is well known, such aliasing would lead to inaccurate recovery of the data unless a corrective action is taken.

Brief Summary Text (10):
The problem may be exacerbated by the fact that the HPNA signals are relatively strong (voltage swing of 0-2 Volts typically) compared to the ADSL related signals (few hundred milli-volts) particularly in the case of long local loops. As an

illustration, if the ADSL signals component is desired to be amplified by a certain degree before sampling by an ADC, the ADC would need to operate at a fairly high voltage swing (due to the higher voltage strength of the HPNA signals) if the ADC were to sample the combined HPNA and ADSL signals. Operating at such high voltage swing may be undesirable in many environments at least due to the higher electrical power requirements. While the problem is described above with respect to ADSL for illustration, similar problems may be encountered with other types of DSL technologies also.

Brief Summary Text (11):
Accordingly, what is needed is a method and apparatus which enables a DSL modem to operate in conjunction with home networking technologies such as those based on HPNA.

Brief Summary Text (14):
In one embodiment, the filter is implemented as an analog bandpass filter which attenuates the HPNA signals to less than -150 dBm/Hz. The number -150 dBm/Hz represents the desired noise floor for the ADSL signals in several environments. Attenuation to such low desired levels using analog components may lead to solutions which require high electrical power, and may thus be undesirable.

Brief Summary Text (15):
Accordingly, in an alternative embodiment, the filter is implemented to contain a high pass filter, an amplifier and a low pass filter. The high pass filter filters the low frequency components such as the ADSL transmit echo signal and the telephone voice signal. The output of the high pass filter is amplified and then provided to a low pass filter, which filters the undesirable high frequency components such as the HPNA signals. Due to the prior amplification, the noise requirements of the low pass filter are reduced and the implementation is simplified.

Brief Summary Text (16):
According to yet another aspect of the present invention, the high pass filter is implemented to limit the high frequencies also to some extent. A resistor may be added in series with an input capacitance (of the high pass filter). The resistor attenuates the high frequency signals (including HPNA related) to some extent. When subsequent components are designed to operate with a desired voltage level ceiling, the attenuation (by the resistor) allows for greater amplification in such subsequent components. Specifically, in the described embodiments, the output signals of the resistors (or the high pass filter) may be amplified to a greater extent prior to passing through the low pass filter, thereby further simplifying the implementation of the low pass filter.

Brief Summary Text (17):
According to one more aspect of the present invention, an equalizer may be included between the high pass filter and the low pass filter. The equalizer compensates for the difference of attenuations different frequency components are subjected to when transmitted on local loops. The output of the low pass filter is sampled to generate multiple samples at a high frequency. The samples may be examined later to recover the data encoded in the ADSL signal component.

Drawing Description Text (6):
FIG. 4 is a block diagram illustrating the details of a filter which enables the recovery of data encoded in ADSL signals in accordance with an aspect of the present invention;

Detailed Description Text (3):
Filters which attenuate the HPNA related signals to less than the noise floor of the ADSL signals are provided in accordance with an aspect of the present invention. In many ADSL environments, the desired noise floor is -150 dBm/Hz

(decibel milli per hertz). For further details of ADSL, the reader is referred to a document entitled, "ITU-T Recommendation: G.922.1: Asymmetrical Digital Subscriber Loop Transmission" dated July 1999, and is available from International Telecommunication Union, and the document is incorporated in its entirety into the present application.

Detailed Description Text (7):
Continuing with combined reference to FIGS. 1 and 2, telephone set 130 enables telephone conversations between end users using frequency band 210 (i.e., 0-4 KHZ) on telephone line 127, and may be implemented in a known way. Computer systems 150 and 160 may be implemented to communicate with each other using HPNA standard using frequency band 270 (i.e., 4-10 MHZ) on telephone line 127, and may also be implemented in a known way.

Detailed Description Text (10):
Assuming that CPE 120 operates consistent with ADSL specification, CPE 120 may transmit data using frequency band 230 (i.e., 30-138 KHZ) on telephone line 127, and the transmit operation may be performed in a known way. During reception, CPE 120 receives a signal which contains DSL data (band 250), any transmissions according to the HPNA specifications (band 270), and voice band 210. The manner in which CPE 120 recovers the data in DSL data channel in accordance with various aspects of the present invention is described below.

Detailed Description Text (13):
ADC 330 may be implemented to generate 12 bit samples at a frequency of 4.416 Mega Samples per Second. ADC 330 may be implemented for a voltage swing of about 3 Volts. Gain amplifier 320 receives the output of filter 310 and amplifies the received signal by about 36 Db to generate the input to ADC 330. In an embodiment, ADC 330 and gain amplifier 320 may be integrated as one unit, and be referred to as a analog front end (AFE). Post processor 350 processes the samples generated by ADC 330 to recover the data encoded in the ADSL channel (band 250). ADC 330 gain amplifier 320, and post processor 350 may be implemented in a known way.

Detailed Description Text (14):
In one embodiment, filter 310 is implemented as an analog filter containing components such as resistors and capacitances. The signal received on telephone line 127 contains the four bands 210, 230, 250 and 270 of FIG. 2. The undesirable HPNA related signals of band 270 need to be attenuated by 90 dB such that the attenuated HPNA signals would have a signal strength of less than the desired noise floor of -150 dBm/Hz.

Detailed Description Text (15):
Thus, by attenuating the HPNA signals to less than -150 dBm/Hz strength, one can ensure that the aliased component (which is part of the undesirable noise) is below the noise floor of the ADSL signal. That is, the signal quality is not further degraded due to the HPNA signal component. The result is that the data recovery rate (of the ADSL channel) is not degraded by the presence of the HPNA signals on telephone line 127.

Detailed Description Text (16):
The above goal of attenuation (of HPNA signal by 90 dB) can be achieved by a 6.sup.th order low pass filter. The low pass filter may be implemented using either active or passive components. In the case of passive components (physical resistors, capacitors as external components), the overall cost of implementing filter 310 is enhanced, and may be unacceptable particularly in consumer markets where cost is of particular importance. In addition, the passive components may occupy an unacceptable amount of space, and thus the solution may be further undesirable.

Detailed Description Text (25):

In one embodiment, LPF 480 is implemented as a 4.sup.th order elliptic filter followed by a 2.sup.nd order filter. The filtering is broken down into two stages so as to have independent control over the zeros of the transfer function and maximize the attenuation. The zeros may be placed at 4.7 MHZ and 6.1 MHZ to achieve the desired attenuation of the HPNA signals. As LPF 480 is placed after the PGAs, the noise specification of these two filters is reduced, and may be implemented with minimal power consumption.

Detailed Description Text (33):
It may be noted that the output of HPF 450 of FIG. 6A contains band 270 (HPNA signals), which have a relatively high voltage level. The high voltage levels limit the amplification levels in PGA 420, assuming that it is upper voltage limit of the amplified signal is set at a desired pre-set value. However, substantial attenuation (amounting to near removal) of band 270 may require that HPF 450 be replaced by a band-pass filter, which is undesirable at least for reasons noted above.

Detailed Description Text (36):
Thus, by using resistances RC1 and RC4, the HPNA signals of band 270 can be attenuated to some degree. As a result, the signal can be amplified further in PGA 420 before passing through LPF 480. Due to the amplification, the implementation of LPF 480 is simplified, yet using minimal electrical power. In addition, the resistances RC1 and RC4 can be implemented with fairly minimal additional cost as the resistances can be easily incorporated into a single integrated circuit implementing CPE 120. Thus, an aspect of the present invention provides a low cost filter which consumes minimal power.

CLAIMS:

1. A device for accurately generating a plurality of samples representing data encoded according to a digital subscriber line (DSL) specification, said data being encoded in a DSL signal and being received on a telephone line, said telephone line being shared by other devices used for home networking, said device comprising: a filter coupled to said telephone line, said filter receiving an input signal on said telephone line and attenuating signal components corresponding to said home networking to generate a filtered output; a first amplifier amplifying said filtered output to generate an amplified signal; and an analog to digital converter (ADC) sampling said amplified signal to generate said plurality of samples; wherein said filter comprises a high pass filter including a first resistor in series with an input capacitance, wherein said first resistor has a resistance substantially more than the internal resistance of said input capacitance.

4. The device of claim 3, wherein said DSL comprises Asymmetric DSL (ADSL), and said home networking is performed according to home phone networking alliance (HPNA) standard, wherein said desired noise floor equals -150 dBM/Hz.

15. The filter of claim 14, wherein said DSL comprises Asymmetric DSL (ADSL), and said home networking is performed according to home phone networking alliance (HPNA) standard, wherein said desired noise floor equals -150 dBM/Hz.

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US006831975B1

(12) **United States Patent**
Easwaran et al.

(10) **Patent No.: US 6,831,975 B1**
(45) **Date of Patent: Dec. 14, 2004**

(54) **DIGITAL SUBSCRIBER LINE (DSL) MODEM COMPATIBLE WITH HOME NETWORKS**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 808 days.

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(22) Filed: **Sep. 13, 2000**

(51) **Int. Cl.**[7] **H04M 1/00**

(52) **U.S. Cl.** **379/390.02**; 379/387.02; 379/399.01; 379/413.02

(58) **Field of Search** 379/390.01–390.04, 379/394, 395, 392.01; 375/220, 222, 219, 261, 269, 376

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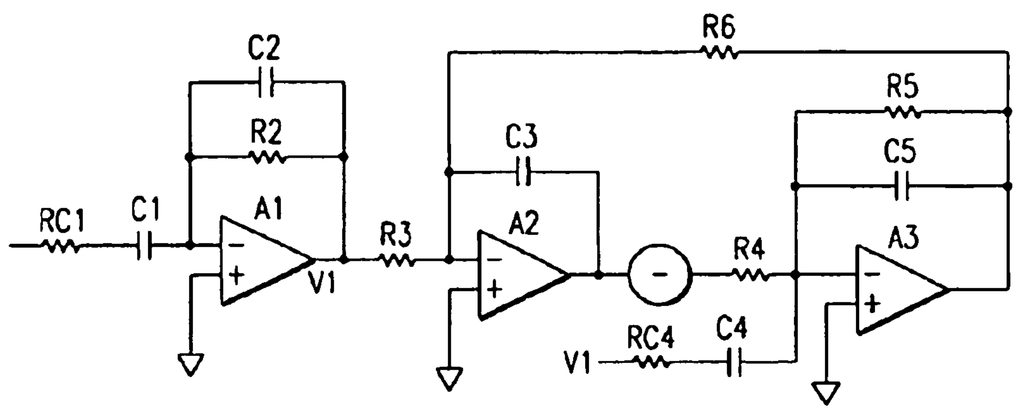
(57) **ABSTRACT**

A cost-effective filter consuming low power and occupying minimal space. The filter may be used in a ADSL modem (or CPE) to filter the signal components other than the ADSL signals. A high pass filter first filters the low frequency components to attenuate (or remove) lower frequency components such as that caused by ADSL transmit echo signals and that used for voice transmission. The high pass filter may be modified by adding a few resistors to limit the voltages of the high frequency signals also. The output of the high pass filter is amplified and passed through a low pass filter to filter the high frequency components (HPNA included). Due to earlier filtering operation of the high pass filter, the signal can be amplified substantially before being sent to the low pass filter. The implementation of the low pass filter is simplified due to the prior amplification.

18 Claims, 2 Drawing Sheets



L6: Entry 4 of 10 File: USPT Feb 24, 2004

DOCUMENT-IDENTIFIER: US 6697358 B2
TITLE: Emulation of phone extensions in a packet telephony distribution system

Brief Summary Text (10):
Another technology is powerline networking, which permits packet data networking over AC power lines in the home. An industry standard for powerline networking is HomePlug (HomePlug Powerline Alliance). HomePlug permits power outlets to provide a power source and also provide network ports for packet data networking. Since multiple power outlets are more common in a home than multiple phone line jacks, there is typically no need to install new in-home wiring.

Detailed Description Text (15):
The primary functions of digital signal processor 430 are processing packet telephony signals and data. Digital signal processor 430 also controls SLIC 455 and bypass relay 460. Networking interface 420 functions according to the HomePNA, HomePlug, HomeRF, or other networking standard. Further, when the derived phone line and the analog phone line share the same copper wire-pair, such as HPNA, networking interface 420 can distinguish between data packets and analog signals. Codec 450 is further coupled to SLIC 455, which is coupled to bypass relay 460. Typically, codec 450 has the functionality of a standard off-the-shelf coder/decoder and SLIC 455 performs electrical signaling, such as monitoring voltage levels and ring generation.

L6: Entry 8 of 10 File: USPT Feb 25, 2003

DOCUMENT-IDENTIFIER: US 6526581 B1
TITLE: Multi-service in-home network with an open interface

Brief Summary Text (22):
In the preferred embodiments, the internal and external interfaces take the form of plug-in cards. As such, it is relatively easy to add, remove or change cards as desired, to provide the interconnections currently appropriate for a particular customer's premises. By using available interfaces, it is possible to install the inventive gateway so as to provide selective connections to any desirable combination of two or more of: telephone lines (POTS, ISDN, DSL, T1, etc.), coaxial cable links for cable modem service or for more advanced digital broadband cable services, wireless digital communication networks, and/or local or wide area data networks outside the premises. Within the premises, the gateway may interface to telephone wiring, the in-home power line circuitry; an in-home wireless link, a customer premises local area network, or the like as well as combinations of two or more of these in-home media.

Detailed Description Text (12):
In the illustrated embodiment, the gateway 13 connects to two separate in-home media, each of which uses existing wiring in the home. One media 21 may provide digital communications over twisted pair telephone wiring in the home. The other illustrated media 23 provides digital carrier communications over the existing AC power line circuitry within the premises. The illustrated gateway 13 includes appropriate interface cards to enable connection to and two-way digital communication over the telephone wiring 21 and over the power line 23.

Detailed Description Text (13):
There are actually more technical difficulties with communications over the power line 23, making the interfaces for communication via such media more complex and expensive However, there are power outlets for connections all over the premises. In contrast, the telephone wiring communication is easier to implement technically, but there are fewer outlets for connections to the line 21, and as a result, many devices in the home are not located for easy access to a telephone line jack.

Detailed Description Text (15):
An appropriate control device 41C controls appliances, such as 41. The control device 41C may send appliance status information or alarms and/or receive control command codes via the network 11. Video devices, such as the TV 42 and/or a VCR (not shown) also send and/or receive digital signals via the network 11. It is also envisioned that the user will have one or more personal computers (PCs) 43 coupled to the network. The PC preferably provides a user interface to allow monitoring and control of other devices on the network 11 and provides a terminal for the user interface to the gateway 13. Devices such as appliance control 41C, TV 42 and PC 43 may connect to the first media 21, or as shown, they may connect to a second available media, such as the power line 23.

Detailed Description Text (16):
In accord with the invention, each device connects to one of the physical in-home media 21 or 23 through a device interface D. Looking toward the network side, each such device interface provides a physical connection to the network media 21 or 23

and two-way digital communication over the media, in accord with the standard protocol utilized on that media. For example, the D1 interfaces 311, 312, 313, 314 implement an HPNA (Home Phoneline Network Alliance) standard interface protocol for digital communication over the twisted wire pair 21. The D2 interfaces 321, 322, 323 implement one of the available protocols for carrier communication over the power line 23.

Detailed Description Text (19):
The other device interfaces would similarly implement appropriate interfaces for the respective devices. The D2/3 and D1/3 interfaces (323, 313) would implement one or more digital port type interfaces, standardized for PCs and computer peripheral devices. The interface 313 for example, would typically implement a standard parallel printer port interface. The device interfaces 311 and 322 would implement interfaces that have been standardized for audio and/or video entertainment system components. The D2/1 interface 321 would implement a physical interface similar to that provided within X-10 compatible control devices communicating over power lines. The device 314 would implement an interface appropriate to the particular home alarm system 34.

Detailed Description Text (30):
The network 11 preferably can support any analog services provided by the external networks. For example, the ADSL modem 115 and the HPNA interface 121 would provide baseband analog service through the interconnection 127, from the line 15 over the wire 21 directly to a standard telephone 32, e.g. for local and emergency calls. If the CATV link 17 provides standard RF broadcast service together with the cable modem service, the cable modem 117 could provide an analog link for the broadcast channels to an RF port of the TV 42 or other video devices not shown.

Detailed Description Text (31):
The gateway also includes one or more interface cards for connection to and communication via the internal media. In the example shown in the drawings, the router connects through the HPNA compatible interface card 121 to the twisted pair telephone wiring 21. The router also connects through a power line data communication interface 123 to the in-home power line 23. If the user has additional media, such as a wireless local data link or an Ethernet LAN, the gateway 13 would include other interface card(s) 125 matching the additional in-home media. The internal media interfaces provide physical and electrical connections to the media, and each interface provides two-way conversions between the protocol used on the respective meter and the protocol of the router. The router 103 provides packet-switched routing to and from the various interfaces 121, 123 and 125, to enable communication between the various devices within by the premises. The router also provides packet-switched routing for the various interfaces 121, 123 and 125 to and from external interfaces 115, 117 and 119 through the firewall 101.

Detailed Description Text (33):
The CPU 105 implements an operating system and a communication application that control the necessary functions of the router 103 and the firewall 101 to prioritize and route various communications between the internal devices and between the devices and the external communication facilities. The gateway software also implements functions matching the common API implemented by the device specific interfaces. The operating system and communication application are designed to automatically detect a new device and interface when connected to the network 11 and to interact with such a new device interface to configure the gateway and the new interface to enable communications through the system 11. From the user's perspective, if the user plugs in a new device specific interface and associated device into the power line 23 or into the in-home telephone wiring 21, the network 11 executes the necessary configuration routines and automatically enables communications for the new device.

Detailed Description Text (36):
FIG. 3 shows the logical hierarchy of functions of any one of the device specific interfaces. At the lowest level, the device-specific interface provides a physical (PHY) interface 44 to the particular in-home network media. For example, this function entails actually sending and receiving electrical signals over the media. The next function entails media access control (MAC) 44. This function will vary depending on the protocol utilized on the particular media. In general, the MAC function 44 determines when the particular device gains access to the media, for sending or receiving digital information over the media. For example, in a protocol wherein each device on a local network media 21 or 23 has an address, the MAC controls the address related functions, such as sending address signals and recognizing address signals in received data signals. The MAC control functionality together with the actual physical network interface 44 provide a physical media interface, for example to the in-home telephone line 21, to the in-home power line 23 or to any other in-home media utilized in the particular installation. For the twisted pair telephone line interface, these elements might take the form of a standard chip set built to the HPNA standard, such as a chipset available from Epigram of Sunnyvale, Calif., e.g. for providing 10 Mb/s digital communications over the in-home telephone line 21.

Detailed Description Text (40):
An interface for a data device, such as the interface 323 for the PC 43, preferably takes the form of a LAN card. The card provides the physical interface to a particular type of port or bus in the PC 43 or other data device 33 and provides the physical interface to the particular type of in-home LAN media, in the illustrated example to the power line 23, or to the twisted pair 21 or other in-home media. The LAN card type interface 323 would also provide the protocol conversion between the protocols used within the PC or peripheral and on the in-home network 11 and would implement the application software to convert between the message set of the API and the message set utilized by the PC 43.

Detailed Description Text (46):
As noted earlier, the twisted pair 21 supports analog POTS service to the telephone 32, as well as the digital communication services, for example utilizing a multiplexing/splitting technique through the ADSL modern 115. The telephone interface 312 includes an HPNA interface 63 or the like for connection to the twisted pair telephone wiring 21. Like the ADSL modem, the HPNA interface provides two-way digital communication as well as baseband analog telephone communication. The analog interface 55 normally passes the baseband analog telephone signals over the link 56 and through the HPNA interface 63, to provide POTS service access to the line 21 for the telephone 32. Upon detection of a predetermined dialed digit or code, for example the dialing of a "9," the .mu.P controller 59 would activate the digital functions of the interface 312 and disconnect the link 58. Similarly, the .mu.P controller 59 would activate the digital functions and disconnect the link 56 in response to an incoming digital call.

Detailed Description Text (49):
The PAD 61 in turn sends packets to and receives packets from the HPNA interface 63. Although other physical media interfaces could be used, in the example, it was assumed that the telephone 32 communicated via the twisted pair media 21. For purposes of discussion, it is assumed that communication via twisted pair 21 conforms to the HPNA standard, although other forms or communication or other media may be used. The interface 63 provides the physical conversions necessary to communicate the packet data to and from the PAD 61 via the twisted pair media, to communicate with the gateway 13 and other devices coupled to the media 21.

Detailed Description Text (50):
Logically, the HPNA interface 63 implements the physical network interface 44 and the MAC function 45. The .mu.P controller 59 implements the operating system (OS) and the application program interface (API) at level 46. The special programming

for the .mu.P controller 59 also implements the device-specific application 47, in this case the application for TCP/IP communication (using PAD 61) and for interaction with a POTS telephone 32. The .mu.P controller 59 controls the analog interface 55 to provide the actual physical interface 48 to the telephone 32.

CLAIMS:

5. A system as in claim 1, wherein the internal communication media comprises at least one media selected from the group consisting of: telephone wiring, power line wiring, a customer premises wireless link, and a local area network media.

7. A system as in claim 6, wherein: one of the internal communication media within the premises comprises telephone wiring; and another one of the internal communication media within the premises comprises power line wiring.

16. A gateway as in claim 14, wherein the internal interface comprises an interface selected from the group consisting of: a power line data communication interface, a telephone line data communication interface, a local wireless data communication interface and a local area network interface.

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L7: Entry 3 of 6 File: USPT Dec 14, 2004

DOCUMENT-IDENTIFIER: US 6831945 B1
TITLE: Method and apparatus for remote identification of transmission channel interference

Abstract Text (1):
A method is provided for monitoring transmission signal interference in a bi-directional transmission/reception system in which a modulated signal received at a receiver location is subjected at the receiver location to analog to digital (A/D) conversion by an A/D converter 3, an output of which is routed to an input of a digital demodulator 6 for demodulation. The method includes the steps of accessing the output of the A/D converter 3 before the output is subjected to demodulation by the demodulator 6 and storing the accessed data in a storage buffer 7. The data stored in the storage buffer 7 is available for inspection to assist in determining the presence of signal interference.

Brief Summary Text (8):
FIG. 2 is a block diagram illustrating in somewhat more detail the components of the typical DSL system shown in FIG. 1. Broad-band data content, such as Internet and video, to be transmitted downstream to the subscriber is first supplied to digital modulator 5, a component of the DSL modem located at the service provider, in this case the central office. Today, broad-band data is typically coded as multibit words and modulated onto digital representations of the carrier or carriers in the digital domain, depending on the type of modulation. The signal is then passed through a digital to analog (D/A) converter generating an analog signal for transmission over twisted pair 4. The signal generated is then combined, using combiner/splitter 1, with the telephone signal to produce the complete downstream signal.

Brief Summary Text (10):
In twisted pair copper loop networks, such as those illustrated in FIGS. 1 and 2, signals are transmitted in differential mode and any Radio Frequency Interference (RFI) normally will be picked up by both wires of the twisted pair approximately equally with the desired signal being determined by the signal between the wires at the receiver. However, even with such inherent interference-canceling attributes, differential lines still may be subject to occasional electrical interference which can interrupt or degrade service. Such interference is often intermittent and may be caused by licensed services such as Amateur Radio or the Military, or by unlicensed services such as power lines or industrial equipment.

Brief Summary Text (12):
However, the digital modulation techniques that have been developed to provide high bandwidth DSL service on POTS lines are severely affected by the presence of interference and such interference is much harder to detect in DSL transmissions, as compared to voice-band telephone service, since DSL operates in frequency bands above the audible range. As a result, measurements must be made at higher frequencies, above the traditional telephone frequency band, requiring special equipment.

Brief Summary Text (17):
In consideration of the above problems, in accordance with one advantageous aspect

of the present invention, a method is provided for monitoring transmission signal interference in a bi-directional transmission/reception system in which a modulated signal received at a receiver location is subjected at the receiver location to analog to digital (A/D) conversion by an A/D converter, an output of which is routed to an input of a digital demodulator for demodulation. The method comprises: accessing the output of the A/D converter before the output is subjected to demodulation by the demodulator; and storing the accessed data in a storage buffer. The data stored in the storage buffer is available for inspection to assist in determining the presence of signal interference.

Brief Summary Text (18):
In accordance with another aspect of the present invention, there is provided a system operable to receive a modulated downstream signal and transmit a modulated upstream signal. The system comprises: a receiving subsystem comprising an analog to digital (A/D) converter that digitizes the received downstream signal, and a demodulator that demodulates the digitized downstream signal; a transmitting subsystem comprising a modulator that modulates upstream data for transmission in the upstream signal and a digital to analog (D/A) converter that D/A converts the modulated upstream data to produce an analog upstream signal; and a channel monitoring and reporting subsystem. The channel monitoring and reporting subsystem comprises: means for accessing the output of the A/D converter; a memory buffer that temporarily stores samples of the accessed output of the A/D converter; and a combining circuit, responsive to receipt of a command or the expiration of a predetermined time interval, that combines data corresponding to the stored samples with the upstream channel data before modulation for transmission.

Brief Summary Text (19):
In accordance with another aspect of the present invention, there is provided a bi-directional communication system for communication between a service provider and a subscriber, the system comprising: (a) a subscriber system operable to receive a modulated downstream signal from the service provider and transmit a modulated upstream signal to the service provider; and a provider system. The subscriber system comprises: a subscriber receiving subsystem comprising a subscriber analog to digital (A/D) converter that digitizes the received downstream signal, and a subscriber demodulator that demodulates the digitized downstream signal; a subscriber transmitting subsystem comprising a subscriber modulator that modulates upstream data for transmission in the upstream signal and a subscriber digital to analog (D/A) converter that D/A converts the modulated upstream data to produce an analog upstream signal; and a subscriber channel monitoring and reporting subsystem comprising: means for accessing the output of the subscriber A/D converter; a memory buffer that temporarily stores samples of the accessed output of the subscriber A/D converter; and a combining circuit, responsive to receipt of a command or the expiration of a predetermined time interval, that combines data corresponding to the stored samples with the upstream channel data before modulation for transmission. The provider system comprises: a provider receiving subsystem comprising a provider analog to digital (A/D) converter that digitizes a received upstream signal from the subscriber, and a provider demodulator that and demodulates the digitized downstream signal; a provider transmitting subsystem comprising a provider modulator that modulates downstream data for transmission in the downstream signal and a provider digital to analog (D/A) converter that D/A converts the modulated downstream data to produce an analog downstream signal.

Brief Summary Text (20):
In accordance with yet another aspect of the present invention, there is provided an apparatus for receiving and transmitting modulated signals over a transmission medium and monitoring transmission signal interference occurring over the medium. The apparatus comprises: an analog to digital (A/D) converter for converting incoming modulated signals and outputting a digital representation of the modulated signals; demodulation means for inputting the digital representation of the modulated signals and demodulating the input signals; accessing means for accessing

the output of the A/D converter before the output is subjected to demodulation by the demodulation means; and storing means for storing the accessed data in a storage buffer, the data stored in the storage buffer being available for inspection to assist in determining the presence of signal interference.

Brief Summary Text (21):
In accordance with still another aspect of the present invention, there is provided a computer-readable medium storing code for causing a processor-controlled apparatus to perform a method for monitoring transmission signal interference in a bi-directional transmission/reception system in which a modulated signal received at a receiver location is subjected at the receiver location to analog to digital (A/D) conversion by an A/D converter, an output of which is routed to an input of a digital demodulator for demodulation. The method comprises: accessing the output of the A/D converter before the output is subjected to demodulation by the demodulator; and storing the accessed data in a storage buffer, the data stored in the storage buffer being available for inspection to assist in determining the presence of signal interference.

Detailed Description Text (10):
In either of the above implementations, digital data representing a sample or samples of the condition of the transmission signal is available in the storage buffer 7. To effect remote access to the stored samples requires that the samples be prepared for transmission on the upstream data channel. To achieve this function, on command, or at predetermined intervals, the samples stored in storage buffer 7 are read from the buffer and inserted in the digital upstream data path, pre-modulation, using multiplexer 8, as shown in FIG. 3. Preferably, to avoid interrupting upstream service, this is effected during periods when the upstream data channel is not bursting data.

Detailed Description Text (11):
In preparation for transmission upstream, the output of multiplex 8 is subjected to digital modulation by modulator 5. The output of modulator 5 is then routed to a D/A converter 2, and the resulting signal combined with the upstream POTS signal and transmitted upstream over the subscriber's twisted pair 4, to be received at the service provider. Upon receipt by the service provider, the received upstream data is split by combiner/splitter 1 into the POTS signal component and the broad-band signal component. The separated broad-band signal is routed to A/D converter 3 and then is demodulated by digital demodulator 6. At this point, demultiplexer 9 separates the output of the demodulator 7 into the upstream communication data and the channel condition data that has been piggy-back transmitted for diagnosis. The thus-separated channel condition data can then be forwarded to a central location for signal processing and analysis.

Detailed Description Text (19):
As was discussed above, the present invention provides a channel monitoring technique that is also applicable to any digital communications system that also digitizes the incoming communications channel signal prior to demodulation. Such systems include but are not limited to: Digital HFC (Hybrid Fiber Coax) networks, HPNA (Home Personal Network Architecture), and Digital Wireless Systems such as CDMA, PCS, and GSM.

Detailed Description Text (21):
Further, since the present invention advantageously monitors a digital representation of the line itself, prior to demodulation, it is completely independent of the type of modulation scheme used in the system being monitored. Thus, the present invention can be used regardless of whether the transmission system uses discrete multitone (DMT) modulation, quadrature amplitude modulation (QAM), or carrierless amplitude phase (CAP).

CLAIMS:

1. A method for monitoring transmission signal interference in a bi-directional transmission/reception system in which a modulated signal received at a receiver location is subjected at the receiver location to analog to digital (A/D) conversion by an A/D converter, the method comprising: separately routing an output of the A/D converter to a digital demodulator and to a storage buffer; demodulating the output of the A/D converter in the digital demodulator to produce downstream data; storing the output of the A/D converter as data in the storage buffer, the data stored in the storage buffer being available for inspection to assist in determining the presence of signal interference.

2. A method for monitoring transmission signal interference in a bi-directional transmission/reception system in which a modulated signal received at a receiver location is subjected at the receiver location to analog to digital (A/D) conversion by an A/D converter, the method comprising: routing an output of the A/D converter to a digital demodulator; demodulating the output of the A/D converter in the digital demodulator to produce downstream data; accessing the output of the A/D converter before the output is subjected to demodulation by the demodulator; and storing the accessed data in a storage buffer, the data stored in the storage buffer being available for inspection to assist in determining the presence of signal interference, wherein the accessing step is performed responsive to receipt of a sampling command, or is performed at predetermined intervals.

7. A system operable to receive a modulated downstream signal and transmit a modulated upstream signal, the system comprising: a receiving subsystem comprising an analog to digital (A/D) converter that digitizes the received downstream signal, and a demodulator that demodulates the digitized downstream signal to produce downstream data; a transmitting subsystem comprising a modulator that modulates upstream data for transmission in the upstream signal and a digital to analog (D/A) converter that D/A converts the modulated upstream data to produce an analog upstream signal; and a channel monitoring and reporting subsystem comprising: means for accessing the output of the A/D converter before the output is subjected to demodulation by the demodulator; a memory buffer that temporarily stores samples of the accessed output of the A/D converter, the samples being available for inspection to assist in determining the presence of signal interference; and a combining circuit, responsive to receipt of a command or the expiration of a predetermined time interval, that combines data corresponding to the stored samples with the upstream channel data before modulation for transmission.

9. A system according to claim 7, wherein the downstream and upstream modulated signals include digital subscriber line (DSL) signals, the system is located at a DSL subscriber location, the downstream modulated signal originates at a DSL service provider and the upstream modulated signal is transmitted by the system to the DSL service provider.

10. A system according to claim 9, wherein the received downstream signal contains DSL signals and telephone signals multiplexed together and the system further comprises: a combiner/splitter that: from the multiplexed downstream channel signal, separates the DSL signal from the telephone signal and routes the DSL signal to the A/D converter and the telephone signal to a subscriber telephone; and combines the upstream modulated channel with outgoing telephone signals to form a multiplexed upstream channel signal.

11. A bi-directional communication system for communication between a service provider and a subscriber, the system comprising: (a) a subscriber system operable to receive a modulated downstream signal from the service provider and transmit a modulated upstream signal to the service provider, the subscriber system comprising: a subscriber receiving subsystem comprising a subscriber analog to digital (A/D) converter that digitizes the received downstream signal, and a subscriber demodulator that demodulates the digitized downstream signal to produce

downstream data; a subscriber transmitting subsystem comprising a subscriber modulator that modulates upstream data for transmission in the upstream signal and a subscriber digital to analog (D/A) converter that D/A converts the modulated upstream data to produce an analog upstream signal; and a subscriber channel monitoring and reporting subsystem comprising: means for accessing the output of the subscriber A/D converter before the output is subjected to demodulation by the demodulator; a memory buffer that temporarily stores samples of the accessed output of the subscriber A/D converter the samples being available for inspection to assist in determining the presence of signal interference; and a combining circuit, responsive to receipt of a command or the expiration of a predetermined time interval, that combines data corresponding to the stored samples with the upstream channel data before modulation for transmission; and (b) a provider system comprising: a provider receiving subsystem comprising a provider analog to digital (A/D) converter that digitizes a received upstream signal from the subscriber, and a provider demodulator that demodulates the digitized downstream signal; a provider transmitting subsystem comprising a provider modulator that modulates downstream data for transmission in the downstream signal and a provider digital to analog (D/A) converter that D/A converts the modulated downstream data to produce an analog downstream signal.

13. A system according to claim 11, wherein the downstream and upstream modulated signals include digital subscriber line (DSL) signals.

14. A system according to claim 13, wherein the downstream signal contains DSL signals and telephone signals multiplexed together and the subscriber system further comprises: a subscriber combiner/splitter that: from the multiplexed downstream channel signal, separates the DSL signal from the telephone signal and routes the DSL signal to the A/D converter and the telephone signal to a subscriber telephone; and combines the upstream modulated channel signal with outgoing telephone signals to form a multiplexed upstream channel signal.

15. A system according to claim 14, wherein the upstream signal contains DSL signals and telephone signals multiplexed together and the provider system further comprises: a provider combiner/splitter that: from the multiplexed upstream channel signal, separates the DSL signal from the telephone signal and routes the DSL signal to the A/D converter and the telephone signal to a public switched telephone network (PSTN); and combines the downstream modulated channel signal with outgoing telephone signals from the PSTN to form a multiplexed downstream channel signal.

17. An apparatus for receiving and transmitting modulated signals over a transmission medium and monitoring transmission signal interference occurring over the medium, the apparatus comprising: an analog to digital (A/D) converter for converting incoming modulated signals and outputting a digital representation of the modulated signals; routing means for separately routing the digital representation to: demodulation means for receiving the digital representation of the modulated signals and demodulating the received signals to produce downstream data; storing means for storing digital representation as data, the data stored in the storing means being available for inspection to assist in determining the presence of signal interference.

18. An apparatus for receiving and transmitting modulated signals over a transmission medium and monitoring transmission signal interference occurring over the medium, the apparatus comprising: an analog to digital (A/D) converter for converting incoming modulated signals and outputting a digital representation of the modulated signals; demodulation means for inputting the digital representation of the modulated signals and demodulating the input signals to produce downstream data; accessing means for accessing the output of the A/D converter before the output is subjected to demodulation by the demodulation means; and storing means for storing the accessed data in a storage buffer, the data stored in the storage buffer being available for inspection to assist in determining the presence of

signal interference, wherein operation of the accessing means is responsive to receipt of a sampling command, or is performed at predetermined intervals.

23. A computer-readable medium storing code for causing a processor-controlled apparatus to perform a method for monitoring transmission signal interference in a bi-directional transmission/reception system in which a modulated signal received at a receiver location is subjected at the receiver location to analog to digital (A/D) conversion by an A/D converter, the method comprising: separately routing an output of the A/D converter to a digital demodulator to and to a storage buffer; demodulating the output of the A/D converter in the digital demodulator to produce downstream data; storing the output of the A/D converter as data in the storage buffer, the data stored in the storage buffer being available for inspection to assist in determining the presence of signal interference.

24. A computer-readable medium storing code for causing a processor-controlled apparatus to perform a method for monitoring transmission signal interference in a bi-directional transmission/reception system in which a modulated signal received at a receiver location is subjected at the receiver location to analog to digital (A/D) conversion by an A/D converter, the method comprising: routing an output of the A/D converter to a digital demodulator; demodulating the output of the A/D converter in the digital demodulator to produce downstream data; accessing the output of the A/D converter before the output is subjected to demodulation by the demodulator; and storing the accessed data in a storage buffer, the data stored in the storage buffer being available for inspection to assist in determining the presence of signal interference, wherein the accessing step is performed responsive to receipt of a sampling command, or is performed at predetermined intervals.

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